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ARTMENT OF THE INTERIOR.
AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.
F. V. HAYDEN, IN CHARGE.

BULLETIN 1-2
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OF
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Annual Report.

THE UNITED STATES 7

ENTOMOLOGICAL COMMISSION. 6

DESTRUCTION OF THE YOUNG OR UNFLEDGED LOCUSTS.

No. 1.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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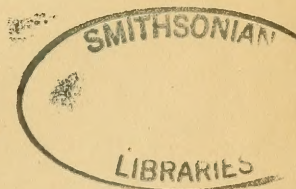
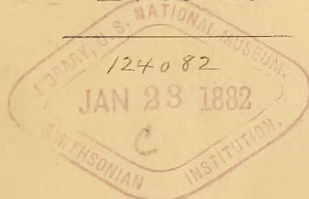
THE UNITED STATES

ENTOMOLOGICAL COMMISSION.

75

DESTRUCTION OF THE YOUNG OR UNFLEDGED LOCUSTS.

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PREFACE.

The publications of the commission will consist of circulars, bulletins, memoirs, and the annual report of doings and results of the work of the Commission. The bulletins will contain such special information as may be of interest and importance at the time of publication. They will be issued partly in anticipation of the annual report, and principally to meet the demand for information and the numerous inquiries made of the Commission at the time. The present number has exclusive reference to the destruction of the young insects which will so largely occupy the attention of our western farmers for the next two months. It will be at once followed by a second number on the natural history and habits of the species.

C. V. RILEY,
A. S. PACKARD, JR.,
CYRUS THOMAS,
Commissioners.

SAINT LOUIS, Mo., *April 2, 1877.*

DESTRUCTION OF THE YOUNG OR UNFLEDGED LOCUSTS.

ARTIFICIAL MEANS.

This bulletin may reach many farmers in the Northwest before the locust-eggs have all hatched. The only feasible way of now destroying these is to plow them deeply under where that is possible. The plowing will be effectual according as the soil is porous or tenacious, *and according as the surface is afterward compressed by harrowing and rolling.* All other things being equal, a plowing of 4 to 6 inches will prove more effectual, if the ground be subsequently harrowed and rolled, than deeper plowing with no subsequent comminution and compression. We advise the farmers in the locust region to supply themselves with early-ripening seed-corn, and to prepare to grow more leguminous and tuberous crops than is the custom. But as the principal struggle during the next two months will be with the young insects, we devote this bulletin more particularly to the best means of overcoming them.

Heavy rolling, where the surface of the soil is sufficiently firm and even, destroys a large number of these newly-hatched young, but is most advantageously employed when they are most sluggish and inclined to huddle together, as during the first eight or ten days after hatching, and in the mornings and evenings subsequently. They then drive almost as readily as sheep, and may be burned in large quantities by being driven into windrows or piles of burning hay or straw. They may also be killed with kerosene, and by means of flattened beating implements; wooden shovels being extensively used for this purpose in Europe.

But to protect the crops and do battle to these young locust armies, especially where, as was the case in much of the ravaged country in 1875, there is little or no hay or straw to burn, the best method is ditching. A ditch 2 feet wide and 2 feet deep, with perpendicular sides, offers an effectual barrier to the young insects. They tumble into it and accumulate, and die at the bottom in large quantities. In a few days the stench becomes great, and necessitates the covering up of the mass. In order to keep the main ditch open, therefore, it is best to dig pits or deeper side ditches at short intervals, into which the 'hoppers will accumulate and may be buried. Made around a field about hatching-time, few 'hoppers will get into that field till they acquire wings, and by that time the principal danger is over, and the insects are fast disappearing. If any should hatch within the inclosure, they are easily driven into the ditches dug in different parts of the field. The direction of the apprehended approach of the insects being known from their hatching locality, ditching one or two sides next to such locality is generally sufficient, and when farmers join they can construct a long ditch which will protect many farms.

We have not a doubt but that with proper and systematic ditching early in the season, when the insects first hatch, nearly everything can be saved. Where water can be let into the ditches so as to cover the bottom, they may be made shallower, and still be effective.

A ditch 3 feet wide, unless correspondingly deep, will be more apt to permit the escape of the insects when once in than a narrower one. In hopping, the more perpendicular the direction the insects must take the shorter will be the distance reached. Of course, the wider the ditch, if it be correspondingly deep, the more effectual will it prove. In exceptional cases, when the locusts are nearly full grown and the wind is high, so as to assist them, even the two-foot ditch loses much of its value.

Next to ditching, the use of nets or seines, or converging strips of calico or any other material, made after the plan of a quail-net, has proved most satisfactory. By digging a pit, or boring a post-auger hole 3 or 4 feet deep, and then staking the two wings so that they converge toward it, large numbers of the locusts may be driven into the pit after the dew is off the ground. By changing the position of this trap, much good can be done when the insects are yet small and huddled in schools. But all modes of bagging, netting, crushing with the spade or other flat implements, and burning, which can be employed to good advantage when the insects first begin to hatch, become comparatively useless when they begin to travel in concert over wide stretches of land. The same may be said of all the mechanical contrivances to facilitate the destruction of the insects; they are useful if used in concert in a given neighborhood soon after the young hatch, but subsequently do not compare to ditching. There are a number of contrivances that have been more or less successfully used, but we cannot treat of all of them in detail. We shall, rather, at this time, content ourselves with descriptions of a few, which will illustrate the principles to be kept in view.

Those used in Minnesota, so far as we can learn, are applications of one principle, viz, an open-mouthed bag, dragged by hand or horsepower. We have seen a very large one that would take from eight to twelve bushels of pupæ per day; but this was after the insects had been pretty effectually fought by burning and otherwise. It was very effective. Its owner proposes to place his whole dependence on it next year. It had one addition over others that we think valuable. It ran back 10 feet or more to a bag, and near the rear end two or three square feet of cloth had been cut out and replaced by wire gauze. This gave a chance for the air to draw through, and as the locusts worked toward the rear end they made way toward the light shining through the wire. This machine was rigged on cart-wheels, and the only expense was in getting three long poles from the woods, and in purchasing about forty yards of cotton muslin.

Maj. J. G. Thompson, of Garden City, Minn., has used with satisfaction a net made as follows:

Two pieces of common batten about 16 feet long were used as frame-work for the mouth of the net, one for the bottom and one for the top. From the end of the bottom piece a wooden shoe of the same material ran back about 6 feet to steady the trap and serve as a runner. To the rear end of this shoe a similar piece was fastened by a hinge, and ran forward and was fastened to the top piece of the frame, so that the mouth of the trap would open and shut like a jaw. To hold the mouth open, two short upright posts were fastened to the top piece by a hinge, and rested upright upon the bed-piece. The net itself was made of cotton cloth for the bottom, and the top was made of mosquito-netting. The mouth of the net extended 16 feet from one side of the trap to the other, and the net ran back about 6 feet to a point with a hole at the end to let out the insects collected. A boy ten years old can draw one end of this net, and by the use of it Major Thompson saved one piece of wheat.

Similar machines have been drawn by horses hitched to each side of the trap, being 12 to 16 feet apart. The horses serve the purpose of driving the locusts inward toward the mouth of the net. There have

been many forms of these machines, but all on the same general principle.

In Colorado, also, machines have been used to good advantage, most of them having for their object the burning of the young insects. Mr. J. Hetzel, of Longmont, uses a burner drawn by horses. It is 12 feet long, 2 to 2½ feet wide, and made of iron, set on runners 4 inches high. An open grate on the top of the runners is filled with pitch-pine wood, and a sheet covers the grate to keep the heat down. The grate is generally made with a net-work of heavy wire, such as telegraph-wire. Two men and a team will burn 10 to 12 acres a day, and kill two-thirds of the insects, but it requires a hot fire. Mr. C. C. Horner gives in the Colorado Farmer the following more detailed description of a machine which works on the same principle:

It consists of three runners made of 2×4 scantling 3 feet in length, to be placed 6 feet apart, making the machine 12 feet wide, runners to be bound together by three flat straps or bars of iron (the base being 12 feet long). Across the top, bars of iron hold the runners firmly together and form a frame across which wire can be worked, to make a grate to hold fire. The upper part of the runners should be hollowed out so that the grate may glide along within 2 inches of the ground. A sheet-iron arch should be set over this grate to drive the heat downward. This machine is very light, and can be worked with one horse. Pitch-wood is best adapted to burning, and can be chopped the right length and size and left in piles where most convenient when needed. This machine is intended to be used when the little 'hoppers just make their appearance along the edge of the grain, going over the ground once or twice each day, or as often as necessary to keep them killed off. The scorching does not kill the grain but makes it a few days later. This is certainly the cheapest manner of getting rid of this pest, as well as the most effectual.

Mr. Rufus Clark, of Denver, according to the same paper, uses a piece of oil-cloth 9 to 12 feet long and 6 feet wide. One side and each end are secured to light wooden strips by common carpet-tacks, and the corners strengthened by braces. The oil-cloth is smeared with coal-tar, purchased at the Denver gas-works for \$7.50 per barrel, and the trap is dragged over the ground by two men, a cord about 10 feet long being fastened to the front corners for that purpose. The entire expense of the "trap" is about \$3.50, and as it is light and easily handled, will be found serviceable on small as well as large farms. Zinc, instead of oil-cloth, has also been used for the same purpose.

When the insects are famishing, it is useless to try and protect plants by any application whatever, though spraying them with a mixture of kerosene and warm water is the best protection we have tried, and will measurably answer when the insects are not too numerous or ravenous.

The best means of protecting fruit and shade trees deserves separate consideration. Where the trunks are smooth and perpendicular they may be protected by whitewashing. The lime crumbles under the feet of the insects as they attempt to climb, and prevents their getting up. By their persistent efforts, however, they gradually wear off the lime and reach a higher point each day, so that the whitewashing must be often repeated. Trees with short, rough trunks, or which lean, are not very well protected in this way. A strip of smooth, bright tin answers even better for the same purpose. A strip 3 or 4 inches wide brought around and tacked to a smooth tree will protect it, while on rougher trees a piece of old rope may first be tacked around the tree and the tin tacked to it, so as to leave a portion both above and below. Passages between the tin and rope or the rope and tree can then be blocked by filling the upper area between tin and tree with earth. The tin must be high enough from the ground to prevent the 'hoppers from jumping from the latter beyond it, and the trunk below the tin, where the insects collect, should be covered with some greasy or poisonous substances to prevent

girdling. This is more especially necessary with small trees, and kerosene or whitewash having Paris green mixed with it will answer as such preventives.

One of the cheapest and simplest modes is to encircle the tree with cotton batting, in which the insects will entangle their feet, and thus be more or less obstructed. Strips of paper covered with tar, stiff paper tied on so as to slope roof-fashion, strips of glazed wall-paper, and thick coatings of soft soap, have been used with varying success; but no estoppel equals the bright tin. The others require constant watching and renewal, and in all cases coming under our observation some insects would get into the trees, so as to require the daily shaking of these morning and evening. This will sometimes have to be done, when the bulk of the insects have become fledged, even where tin is used, for a certain proportion of the insects will then fly into the trees. They do most damage during the night, and care should be had that the trees be unloaded of their voracious freight just before dark.

Most cultivated plants may be measurably protected from the ravages of these young by good cultivation and a constant stirring of the soil. The young have an antipathy to a loose and friable surface, which incommodes them and hinders their progress, and they will often leave such a surface for one more hard and firm.

Finally, though insisting on ditching and the digging of pits as, all things considered, the best and most reliable insurance against the ravages of the young locusts, we would urge our farmers to rely not on these means alone, but to employ all the other means recommended, according as convenience and opportunity suggest.

Another method of destroying the young has been proposed and to a certain extent adopted. It promises, if carried out effectually, to be of much advantage. It is to protect the prairie-grass from fires until spring, and, after the bulk of the eggs are hatched, to simultaneously burn over the entire neighborhood, township, or county, or as far as the combination may extend. This requires concerted action and considerable watchfulness, but if carried out rigidly will destroy a very large number of insects, and has the advantage of being inexpensive. It is inapplicable on the cultivated grounds, but applies to the areas where the other measures are least effective.

NATURAL MEANS.

One of the most effectual means of destroying the young locusts, and one which is too often overlooked because its effects are not so directly apparent, is the preservation and multiplication of the native birds. Without undertaking at this time to specify the species which should be especially protected, and about which there is yet some difference of opinion, we feel warranted in stating that until the useless species in this respect are distinguished from those that are beneficial, it is best to protect all insect-eating birds, and if the laws of the State are insufficient for this purpose, let communities, townships, and counties use all their lawful powers therefor.

Chickens, turkeys, and hogs devour locusts in immense quantities, and thrive during years of locust invasion or whenever these insects abound. Prairie-chickens and quails devour them with avidity, and even hunt for their eggs; swallows and blackbirds pursue them unrelentingly; the little snow-birds devour great quantities of eggs when these are brought to the surface by the freezing and thawing of the ground, and the same may be said of almost all birds inhabiting the western country in winter.

The good offices of birds were everywhere noticed in 1875. Prof. F. H. Snow, of Lawrence, Kans., found the young locusts in the gizzards

of the Red-headed Woodpecker (*Melanerpes erythrocephalus*), Yellow-billed Cuckoo (*Coccyzus americanus*), Cat-bird (*Mimus carolinensis*), Red-eyed Vireo (*Vireo olivaceus*), Great-crested Fly-catcher (*Myiarchus crinitus*), and Crow Blackbird (*Quiscalus versicolor*), species that had not been noticed to feed on them before. The shrike or butcher-bird impales them onto thorns and other pointed substances; and a number of other birds, as well as reptiles, *e. g.*, toads, frogs, and snakes, feed upon them.

We therefore strongly recommend the raising of as large a number as possible of hogs and poultry both as a means of utilizing and of destroying the young locusts.

LEGISLATION.

For the purpose of encouraging the farmers in the work of destroying these pests, three of the States interested, viz, Missouri, Kansas, and Minnesota, have passed laws granting bounties or authorizing combined action. We herewith quote said laws for the benefit of those in these States into whose hands this bulletin may fall.

MISSOURI.

AN ACT to encourage the destruction of grasshoppers.

Be it enacted by the general assembly of the State of Missouri, as follows :

SECTION 1. Any person who shall gather, or cause to be gathered by any person in his employ, eggs of the Rocky Mountain locust or grasshopper, at any time after they are deposited in the earth in the autumn of any year, and before they are hatched the following spring, shall be entitled to a bounty of five dollars for each and every bushel of eggs thus gathered, or for any quantity less than one bushel, bounty at the same rate, to be paid, one-half by the State and one-half by the county in which they are gathered.

SEC. 2. Any person who shall gather, collect, and kill, or cause to be so collected and killed, young and unfledged grasshoppers in the month of March, shall be entitled to a bounty of one dollar for each bushel, and for the month of April, fifty cents per bushel, and for the month of May, twenty-five cents per bushel, to be paid in the same manner as in the preceding section.

SEC. 3. Any person claiming bounty under this act shall produce the eggs and grasshoppers thus gathered or killed, as the case may be, before the clerk of the county court in which such eggs or grasshoppers were gathered or killed, within ten days thereafter, whereupon said clerk shall administer to such person the following oath or affirmation: You do solemnly swear (or affirm, as the case may be) that the eggs (or grasshoppers, as the case may be) produced by you, were taken and gathered by you, or by person or persons in your employ, or under your control, and within this county and State.

SEC. 4. The clerk shall forthwith destroy said eggs by burning the same and give to the person proving up the same, under his hand and seal, a certificate setting forth in a plain handwriting, without interlineation, the amount of eggs or grasshoppers produced and destroyed by him, and the name and residence of such person producing the same, which certificate shall be in the following form:

"STATE OF MISSOURI, County of ———:

"This is to certify that ———, in the county of ———, A. B., did this day prove before me that he had gathered, or caused to be gathered ——— of eggs, ——— grasshoppers, and is entitled to the sum of ——— dollars and ——— cents.

"Given under my hand and seal of my office this ——— day of ———, A. D. 18—.

"———, A. B., Clerk County Court."

Which certificate shall be received and taken by the collector of revenue of the county in which the same was given, and such collector shall be allowed pay out of the county and State treasury, one-half from each.

SEC. 5. Such clerk shall keep a register of all such certificates given by him, in a book which he shall keep for that purpose, in which he shall note down every certificate granted by him, the number and amount, and to whom granted, and transmit a certified copy of such register, under the seal of the court, to the treasurer of the State, who shall not allow and pay any certificate which does not correspond with such register.

SEC. 6. Such clerk shall receive for his services as aforesaid one dollar for such certified copy of the register, and the regular fee for the certificate and seal, and ten cents

for each certificate granted under this act, all to be paid out of the treasury of his county.

SEC. 7. As the object of this act is the rapid destruction of the locust the ensuing spring, it shall take effect and be in force from and after its passage.

Approved February 23, 1877.

[KANSAS.

AN ACT to provide for the destruction of grasshoppers and to punish for violation of this act.

Be it enacted by the legislature of the State of Kansas :

SECTION 1. That the township trustees of the different townships, and the mayors of cities which are not included in any township of any county within this State, are hereby authorized and it is made their duty, when so requested, in writing, by fifteen of the legal voters of the township or city, to issue orders to the road-overseers of the different road districts within their respective townships or cities, to warn out all able-bodied males between the ages of twelve and fifty years within their respective districts for the purpose of destroying locusts or migratory insects.

SEC. 2. It shall be the duty of road-overseers, immediately after receiving said orders, to proceed at once to warn out all persons liable under section one of this act, giving notice of the time and place of meeting, and the tools to be used, and the kind of work expected to be performed, and all work shall be done and performed under the direction of the road-overseers.

SEC. 3. Any persons over eighteen years of age warned out as is provided in this act, may pay the road-overseer the sum of one dollar per day for the time so warned out, and in case any person shall fail to perform labor under this act or paying the sum of one dollar when so warned out, shall be adjudged guilty of a misdemeanor, and on conviction shall be fined the sum of three dollars for each day so failing or refusing, and the moneys so collected shall be expended by the road-overseers in the destruction of grasshoppers in their respective road-districts.

SEC. 4. For the purpose of carrying out the provisions of this act the road-overseer is authorized to enter upon the premises of any person lying within the township where such order of the township trustee is in force, with a sufficient number of hands and teams to perform such labor as he may deem necessary for the public good.

SEC. 5. It shall be the duty of the secretary of the State board of agriculture, immediately after the passage of this act, to compile in circular-form all information relating to the manner and means heretofore used for the extermination of grasshoppers, and send at least ten copies of the same to each township trustee in the State.

SEC. 6. This act shall take effect and be in force from and after its publication once in the Commonwealth.

Approved March 6, 1877.

AN ACT providing for a concert of action by senatorial districts for the destruction of grasshoppers.

Be it enacted by the Legislature of the State of Kansas :

SECTION 1. That in any senatorial district in the State of Kansas where trouble is anticipated from the ravages of young grasshoppers, in the year 1877, and any subsequent year thereafter, it shall be lawful for the counties in said senatorial district to co-operate together in the way and manner herein provided, for the destruction of the same.

SEC. 2. The chairman of the board of county commissioners in the county having the largest number of inhabitants in a senatorial district, where two or more counties form said district, may notify the chairman of each of the boards of county commissioners of the remaining counties in said district, of the time and place when the chairmen of the several boards of commissioners of the respective counties forming said senatorial district shall hold a joint meeting.

SEC. 3. At such meeting two of their number shall be chosen to act as chairman and secretary, and the proceedings of the meeting shall be published in all the newspapers printed in the senatorial district.

SEC. 4. Said meeting shall designate the manner of procedure by road-overseers, and what day or days the young grasshoppers should be driven from the cultivated land on the unburnt prairie or places of destruction, and shall also designate on what day or days the grasshoppers shall be destroyed, by burning or otherwise, in said senatorial district, giving at least ten days' notice of the same by publishing in the newspapers of the said district.

SEC. 5. The board of commissioners of each county shall notify the road-overseers of said county of the time fixed upon by the joint meeting for the driving and burning, or destroying by other means, of the grasshoppers in the district; said notice to be given to said overseers as soon as practicable after the same shall have been determined by the joint meeting.

SEC. 6. Said road-overseer shall immediately notify the residents of his road-district of the time designated and the manner of procedure, in order to carry out the provisions of this act. He shall also specify what tools or implements will be required of each resident in performing the labor required of him; and such notice may be enforced the same as in the acts authorizing road-overseers to warn out the residents to perform road-labor; and a refusal shall subject such persons refusing to the same penalties as are provided by law in such cases.

SEC. 7. The road-overseer shall direct the manner of performing the labor, and have the supervision of the same, and shall keep a list of the names of those who shall perform labor, and shall certify the number of days' work performed by each, and shall place such certified list in the possession of the board of county commissioners of his county.

SEC. 8. It shall be lawful for two or more senatorial districts to co-operate together under the provisions of this act, on a basis of action which they may agree upon.

SEC. 9. This act shall take effect and be in force from and after its publication in the daily Commonwealth.

Approved March 7, 1877.

MINNESOTA.

AN ACT to provide for the destruction of grasshoppers and their eggs.

Be it enacted by the legislature of the State of Minnesota :

SECTION 1. There shall be paid by this State, out of any moneys in the treasury thereof, not otherwise appropriated, to any person or persons living within any of the counties in said State afflicted by grasshoppers, the following bounties for catching and destroying of the same, and the destruction of their eggs.

SEC. 2. The sum of one dollar per bushel for grasshoppers caught previous to the twenty-fifth day of May next. The sum of fifty cents per bushel from the said twenty-fifth day of May to the tenth day of June. The sum of twenty-five cents per bushel from the said tenth day of June to the first day of July; and twenty cents per bushel from the said first day of July to the first day of October next.

SEC. 3. There shall also be paid in the same manner the sum of fifty cents per gallon for any and all grasshopper-eggs taken and destroyed by any person or persons.

SEC. 4. There shall be appointed by the governor a competent person in each township in the several counties so afflicted by grasshoppers, who shall be a resident of the township for which he shall be appointed, to receive, measure, and destroy the grasshoppers and their eggs delivered to him by any person or persons catching and taking the same, which said person so appointed shall take and subscribe an oath for the faithful discharge of his duties, which oath, together with the certificate of appointment, shall be filed in the office of the county auditor, and he shall receive as compensation for his services such sum as the county commissioner may determine, to be paid out of the funds of the county, and in case of necessity, when he cannot perform the duties of his office, said measurer shall have authority and be empowered to appoint a suitable and competent person his assistant, which assistant shall be required to take and subscribe the same oath and be subject to the same penalties as the said measurer.

SEC. 5. The person receiving and measuring the grasshoppers and their eggs as afore-said shall measure and immediately and effectually destroy the same, and keep an exact account of all the grasshoppers and their eggs received by him and the name of the persons delivering the same, and shall issue a certificate for the amount of grasshoppers and their eggs to the person delivering the same. And he shall, at the end of each week after commencing to receive and measure the same, and on the second day of June, on the eleventh day of said month, on the second day of July, and on the second day of October next, make a report to the county auditor of all the grasshoppers and their eggs measured by him, the number of certificates issued, and the names of the persons to whom he issued the same; and the county auditor shall examine the same and file it in his office, which report shall be subject to public inspection; and the county auditor shall, at the end of each week after he shall have received the first of said reports, transmit a copy of the said reports, to the governor, who shall, as soon as the sum hereby appropriated shall have been expended in the payment of said bounties, notify all persons interested therein of such fact by a publication of such notice in some newspaper printed and published at the city of Saint Paul, in said State of Minnesota, for three successive days.

SEC. 6. For a failure on the part of said measurer to perform any of his duties under this act, or for any mismeasurement of such grasshoppers and their eggs, he shall be deemed to be guilty of a misdemeanor, and be subject to pay a fine of not less than ten dollars nor more than one hundred dollars, or be imprisoned in the county jail for a term of not less than thirty nor more than ninety days, in a suit or proceeding to be prosecuted in the name of the State of Minnesota, in the same manner as is provided by law in other cases of misdemeanor.

SEC. 7. Upon the presentation of such certificate to the county auditor, he shall issue a certificate to the person entitled thereto for the amount due him, (a form of which certificate shall be furnished by the State auditor,) and shall make an order upon the State auditor for the amount thereof, and the State auditor shall draw his warrant upon the State treasurer for that amount, in favor of the parties holding said certificates, which shall be paid by the State treasurer on presentation: *Provided*, That all certificates presented to the county auditor for payment shall be by him filed and preserved in his office, and he shall present such certificates to the board of county commissioners, who shall audit the same in the manner now provided by law for auditing accounts against counties; and no money shall be drawn from the State treasury until such certificates have been audited and allowed in the manner herein provided. And that no money shall be paid under the provisions of this act at any time prior to the fifteenth day of July, A. D. 1877, and that the money hereby appropriated shall only apply to certificates duly made and filed with the auditor of State on or before said day; that at the time after the State auditor shall ascertain the total amount of all claims and certificates so filed, and if the same shall exceed in amount the sum of one hundred thousand dollars, then the said claims shall be paid pro rata, and no other or greater amount than said sum of one hundred thousand dollars shall ever be paid under the provisions of this act: *And provided further*, That if the amount hereby appropriated is not sufficient to pay the certificates in full, the balance shall be paid by the counties respectively, according to the amount due on said certificates as issued by such county.

SEC. 8. Every male inhabitant of the several townships in the said afflicted counties, being above the age of twenty-one years and under the age of sixty years, excepting paupers, idiots and lunatics, shall be assessed by the board of supervisors of said township to work one day in each week in said township, during the period hereinafter mentioned for the paying of bounties for the purpose of catching and destroying grasshoppers and their eggs, for five weeks from the time said grasshoppers shall become large enough to be taken; and the amount of work to be so assessed shall not exceed five days in all.

SEC. 9. The supervisors aforesaid shall make a list of the names of all persons against whom said tax shall have been assessed, and place in a column opposite each name on said list the amount of labor assessed against such person, and shall direct the town clerk to make a certified copy of each list, after which the town clerk shall deliver the several copies to the respective overseers of the highways of said townships.

SEC. 10. The overseers of highways shall give at least two days' notice to all persons assessed to work as aforesaid, living within the limits of their respective districts, of the time and places where and when they are to appear for that purpose, and with what implements.

SEC. 11. Every person liable to work, as provided for in this act, may commute for the same at the rate of one dollar per day, in which case such commutation money shall be paid to the chairman of the board of supervisors, to be applied and expended by him for the destruction of grasshoppers and their eggs, and he shall be authorized and required to hire and engage some suitable and efficient person to work in the place of said person so commuting, and to pay him the sum of one dollar per day for his services; and every person intending to commute for his assessment shall, within five days after he is notified to appear and work as aforesaid, pay the commutation money for the work required of him by said notice, and the commutation shall not be considered as made until such money is paid.

SEC. 12. Every person so assessed and notified, who shall willfully neglect or refuse to commute or work as provided by this act, shall be guilty of a misdemeanor, and shall, on conviction thereof, be liable to pay a fine of not less than two dollars nor more than ten dollars, or by imprisonment in the county jail not more than ten days, or both, in the discretion of the court, in a suit to be prosecuted in the name of the State of Minnesota, in the same manner as is provided by law for prosecutions of misdemeanors.

SEC. 13. There shall be appropriated, out of any moneys in the treasury of this State, not otherwise appropriated, for the purpose of carrying out the provisions of this act, the sum of one hundred thousand dollars.

SEC. 14. The board of county commissioners of any county in this State afflicted by grasshoppers, shall have the right, if, in their judgment they see fit, to employ one or more persons in each township in said county with such implements or mechanical contrivances as may prove most efficient to destroy the grasshoppers, from the first day of April to the first day of August in each year, paying such persons either by the day or a specified sum for the amount captured and destroyed. The compensation of such person shall be paid out of the general fund of the county: *Provided further*, That parties employed and paid by the county commissioners shall not receive any other or further compensation under the provisions of this act.

SEC. 15. This act shall take effect and be in force from and after its passage.

Approved March 1, 1877.

DEPARTMENT OF THE INTERIOR.
U. S. GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.
F. V. HAYDEN, IN CHARGE.

BULLETIN

OF

THE UNITED STATES

ENTOMOLOGICAL COMMISSION.

DESTRUCTION OF THE YOUNG OR UNFLEDGED LOCUSTS.

No. 1.

SECOND EDITION.

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PREFACE.

The publications of the Commission will consist of circulars, bulletins, memoirs, and the annual report of doings and results of the work of the Commission. The bulletins will contain such special information as may be of interest and importance at the time of publication. They will be issued partly in anticipation of the annual report, and principally to meet the demand for information and the numerous inquiries made of the Commission at the time. The present number has exclusive reference to the destruction of the young insects which will so largely occupy the attention of our western farmers for the next two months. It will be at once followed by a second number on the natural history and habits of the species.

C. V. RILEY,
A. S. PACKARD, JR.,
CYRUS THOMAS,
Commissioners.

SAINT LOUIS, Mo., *April 2, 1877.*

DESTRUCTION OF THE YOUNG OR UNFLEDGED LOCUSTS.

ARTIFICIAL MEANS.

This bulletin may reach many farmers in the Northwest before the locust-eggs have all hatched. The only feasible way of now destroying these is to plow them deeply under where that is possible. The plowing will be effectual according as the soil is porous or tenacious, *and according as the surface is afterward compressed by harrowing and rolling.* All other things being equal, a plowing of 4 to 6 inches will prove more effectual, if the ground be subsequently harrowed and rolled, than deeper plowing with no subsequent comminution and compression. We advise the farmers in the locust region to supply themselves with early-ripening seed-corn, and to prepare to grow more leguminous and tuberosous crops than is the custom. But as the principal struggle during the next two months will be with the young insects, we devote this bulletin more particularly to the best means of overcoming them.

Heavy rolling, where the surface of the soil is sufficiently firm and even, destroys a large number of these newly-hatched young, but is most advantageously employed when they are most sluggish and inclined to huddle together, as during the first eight or ten days after hatching, and in the mornings and evenings subsequently. They then drive almost as readily as sheep, and may be burned in large quantities by being driven into windrows or piles of burning hay or straw. They may also be killed with kerosene, and by means of flattened beating implements; wooden shovels being extensively used for this purpose in Europe.

But to protect the crops and do battle to these young locust armies, especially where, as was the case in much of the ravaged country in 1875, there is little or no hay or straw to burn, the best method is ditching. A ditch 2 feet wide and 2 feet deep, with perpendicular sides, offers an effectual barrier to the young insects. They tumble into it and accumulate, and die at the bottom in large quantities. In a few days the stench becomes great, and necessitates the covering up of the mass. In order to keep the main ditch open, therefore, it is best to dig pits or deeper side ditches at short intervals, into which the 'hoppers will accumulate and may be buried. Made around a field about hatching-time, few 'hoppers will get into that field till they acquire wings, and by that time the principal danger is over, and the insects are fast disappearing. If any should hatch within the inclosure, they are easily driven into the ditches dug in different parts of the field. The direction of the apprehended approach of the insects being known from their hatching locality, ditching one or two sides next to such locality is generally sufficient, and when farmers join they can construct a long ditch which will protect many farms.

We have not a doubt but that with proper and systematic ditching early in the season, when the insects first hatch, nearly everything can be saved. Where water can be let into the ditches so as to cover the bottom, they may be made shallower, and still be effective.

A ditch 3 feet wide, unless correspondingly deep, will be more apt to permit the escape of the insects when once in than a narrower one. In hopping, the more perpendicular the direction the insects must take the shorter will be the distance reached. Of course, the wider the ditch, if it be correspondingly deep, the more effectual will it prove. In exceptional cases, when the locusts are nearly full grown and the wind is high, so as to assist them, even the two-foot ditch loses much of its value.

Next to ditching, the use of nets or seines, or converging strips of calico or any other material, made after the plan of a quail-net, has proved most satisfactory. By digging a pit, or boring a post-auger hole 3 or 4 feet deep, and then staking the two wings so that they converge toward it, large numbers of the locusts may be driven into the pit after the dew is off the ground. By changing the position of this trap, much good can be done when the insects are yet small and huddled in schools. But all modes of bagging, netting, crushing with the spade or other flat implements, and burning, which can be employed to good advantage when the insects first begin to hatch, become comparatively useless when they begin to travel in concert over wide stretches of land. The same may be said of all the mechanical contrivances to facilitate the destruction of the insects; they are useful if used in concert in a given neighborhood soon after the young hatch, but subsequently do not compare to ditching. There are a number of contrivances that have been more or less successfully used, but we cannot treat of all of them in detail. We shall, rather, at this time, content ourselves with descriptions of a few, which will illustrate the principle to be kept in view.

Those used in Minnesota, so far as we can learn, are applications of one principle, viz, an open-mouthed bag, dragged by hand or horse power. We have seen a very large one that would take from eight to twelve bushels of pupæ per day; but this was after the insects had been pretty effectually fought by burning and otherwise. It was very effective. Its owner proposes to place his whole dependence on it next year. It had one addition over others that we think valuable. It ran back 10 feet or more to a bag, and near the rear end two or three square feet of cloth had been cut out and replaced by wire gauze. This gave a chance for the air to draw through, and as locusts worked toward the rear end they made way toward the light shining through the wire. This machine was rigged on cart-wheels, and the only expense was in getting three long poles from the woods, and in purchasing about forty yards of cotton muslin.

Maj. J. G. Thompson, of Garden City, Minn., has used with satisfaction a net made as follows:

Two pieces of common batten about 16 feet long were used as frame-work for the mouth of the net, one for the bottom and one for the top. From the end of the bottom piece a wooden shoe of the same material ran back about 6 feet to steady the trap and serve as a runner. To the rear end of this shoe a similar piece was fastened by a hinge, and ran forward and was fastened to the top piece of the frame, so that the mouth of the trap would open and shut like a jaw. To hold the mouth open, two short upright posts were fastened to the top piece by a hinge, and rested upright upon the bed-piece. The net itself was made of cotton cloth for the bottom, and the top was made of mosquito-netting. The mouth of the net extended 16 feet from one side of the trap to the other, and the net ran back about 6 feet to a point with a hole at the end to let out the insects collected. A boy ten years old can draw one end of this net, and by the use of it Major Thompson saved one piece of wheat.

Similar machines have been drawn by horses hitched to each side of the trap, being 12 to 16 feet apart. The horses serve the purpose of driving the locusts inward toward the mouth of the net. There have

been many forms of these machines, but all on the same general principle.

In Colorado, also, machines have been used to good advantage, most of them having for their object the burning of the young insects. Mr. J. Hetzel, of Longmont, uses a burner drawn by horses. It is 12 feet long, 2 to 2½ feet wide, and made of iron, set on runners 4 inches high. An open grate on the top of the runners is filled with pitch-pine wood, and a sheet covers the grate to keep the heat down. The grate is generally made with a net-work of heavy wire, such as telegraph-wire. Two men and a team will burn 10 to 12 acres a day, and kill two-thirds of the insects, but it requires a hot fire. Mr. C. C. Horner gives in the Colorado Farmer the following more detailed description of a machine which works on the same principle:

It consists of three runners made of 2 × 4 scantling 3 feet in length, to be placed 6 feet apart, making the machine 12 feet wide, runners to be bound together by three flat straps or bars of iron (the base being 12 feet long). Across the top, bars of iron hold the runners firmly together and form a frame across which wire can be worked, to make a grate to hold fire. The upper part of the runners should be hollowed out so that the grate may slide along within 2 inches of the ground. A sheet-iron arch should be set over this grate to drive the heat downward. This machine is very light, and can be worked with one horse. Pitch-wood is best adapted to burning, and can be chopped the right length and size and left in piles where most convenient when needed. This machine is intended to be used when the little 'hoppers just make their appearance along the edge of the grain, going over the ground once or twice each day, or as often as necessary to keep them killed off. The scorching does not kill the grain, but makes it a few days later. This is certainly the cheapest manner of getting rid of this pest, as well as the most effectual.

Mr. Rufus Clark, of Denver, according to the same paper, uses a piece of oil-cloth 9 to 12 feet long and 6 feet wide. One side and each end are secured to light wooden strips by common carpet-tacks, and the corners strengthened by braces. The oil-cloth is smeared with coal-tar, purchased at the Denver gas-works for \$7.50 per barrel, and the trap is dragged over the ground by two men, a cord about 10 feet long being fastened to the front corners for that purpose. The entire expense of the "trap" is about \$3.50, and as it is light and easily handled, will be found serviceable on small as well as large farms. Zinc, instead of oil-cloth, has also been used for the same purpose.

When the insects are famishing, it is useless to try and protect plants by any application whatever, though spraying them with a mixture of kerosene and warm water is the best protection we have tried, and will measurably answer when the insects are not too numerous or ravenous.

The best means of protecting fruit and shade trees deserves separate consideration. Where the trunks are smooth and perpendicular they may be protected by whitewashing. The lime crumbles under the feet of the insects as they attempt to climb, and prevents their getting up. By their persistent efforts, however, they gradually wear off the lime and reach a higher point each day, so that the whitewashing must be often repeated. Trees with short, rough trunks, or which lean, are not very well protected in this way. A strip of smooth, bright tin answers even better for the same purpose. A strip 3 or 4 inches wide brought around and tacked to a smooth tree will protect it, while on rougher trees a piece of old rope may first be tacked around the tree and the tin tacked to it, so as to leave a portion both above and below. Passages between the tin and rope or the rope and tree can then be blocked by filling the upper area between tin and tree with earth. The tin must be high enough from the ground to prevent the 'hoppers from jumping from the latter beyond it, and the trunk below the tin, where the insects collect, should be covered with some coal-tar or poisonous substances to prevent

girdling. This is more especially necessary with small trees, and coal-tar or whitewash having Paris green mixed with it will answer as such preventives.

One of the cheapest and simplest modes is to encircle the tree with cotton batting, in which the insects will entangle their feet, and thus be more or less obstructed. Strips of paper covered with tar, stiff paper tied on so as to slope roof-fashion, strips of glazed wall-paper, and thick coatings of soft soap, have been used with varying success; but no estoppel equals the bright tin. The others require constant watching and renewal, and in all cases coming under our observation some insects would get into the trees, so as to require the daily shaking of these morning and evening. This will sometimes have to be done, when the bulk of the insects have become fledged, even where tin is used, for a certain proportion of the insects will then fly into the trees. They do most damage during the night, and care should be had that the trees be unloaded of their voracious freight just before dark.

Most cultivated plants may be measurably protected from the ravages of these young by good cultivation and a constant stirring of the soil. The young have an antipathy to a loose and friable surface, which incommodes them and hinders their progress, and they will often leave such a surface for one more hard and firm.

Finally, though insisting on ditching and the digging of pits as, all things considered, the best and most reliable insurance against the ravages of the young locusts, we would urge our farmers to rely not on these means alone, but to employ all the other means recommended, according as convenience and opportunity suggest.

Another method of destroying the young has been proposed and to a certain extent adopted. It promises, if carried out effectually, to be of much advantage. It is to protect the prairie-grass from fires until spring, and, after the bulk of the eggs are hatched, to simultaneously burn over the entire neighborhood, township, or county, or as far as the combination may extend. This requires concerted action and considerable watchfulness, but if carried out rigidly will destroy a very large number of insects, and has the advantage of being inexpensive. It is inapplicable on the cultivated grounds, but applies to the areas where the other measures are least effective.

NATURAL MEANS.

One of the most effectual means of destroying the young locusts, and one which is too often overlooked because its effects are not so directly apparent, is the preservation and multiplication of the native birds. Without undertaking at this time to specify the species which should be especially protected, and about which there is yet some difference of opinion, we feel warranted in stating that until the useless species in this respect are distinguished from those that are beneficial, it is best to protect all insect-eating birds, and if the laws of the State are insufficient for this purpose, let communities, townships, and counties use all their lawful powers therefor.

Chickens, turkeys, and hogs devour locusts in immense quantities, and thrive during years of locust invasion or whenever these insects abound. Prairie-chickens and quails devour them with avidity, and even hunt for their eggs; swallows and blackbirds pursue them unrelentingly; the little snow-birds devour great quantities of eggs when these are brought to the surface by the freezing and thawing of the ground, and the same may be said of almost all birds inhabiting the western country in winter.

The good offices of birds were everywhere noticed in 1875. Prof. F. H. Snow, of Lawrence, Kans., found the young locusts in the gizzards

of the Red-headed Woodpecker (*Melanerpes erythrocephalus*), Yellow-billed Cuckoo (*Coccyzus americanus*), Cat-bird (*Mimus carolinensis*), Red-eyed Vireo (*Vireo olivaceus*), Great-crested Fly-catcher (*Myiarchus crinitus*), and Crow Blackbird (*Quiscalus versicolor*), species that had not been noticed to feed on them before. The shrike or butcher-bird impales them onto thorns and other pointed substances; and a number of other birds, as well as reptiles, *e. g.*, toads, frogs, and snakes, feed upon them.

We therefore strongly recommend the raising of as large a number as possible of hogs and poultry both as a means of utilizing and of destroying the young locusts.

LEGISLATION.

For the purpose of encouraging the farmers in the work of destroying these pests, three of the States interested, viz, Missouri, Kansas, and Minnesota, have passed laws granting bounties or authorizing combined action. We herewith quote said laws for the benefit of those in these States into whose hands this bulletin may fall.

MISSOURI.

AN ACT to encourage the destruction of grasshoppers.

Be it enacted by the general assembly of the State of Missouri as follows :

SECTION 1. Any person who shall gather, or cause to be gathered by any person in his employ, eggs of the Rocky Mountain locust or grasshopper, at any time after they are deposited in the earth in the autumn of any year, and before they are hatched the following spring, shall be entitled to a bounty of five dollars for each and every bushel of eggs thus gathered, or for any quantity less than one bushel, bounty at the same rate, to be paid, one-half by the State and one-half by the county in which they are gathered.

SEC. 2. Any person who shall gather, collect, and kill, or cause to be so collected and killed, young and unfledged grasshoppers in the month of March, shall be entitled to a bounty of one dollar for each bushel, and for the month of April, fifty cents per bushel, and for the month of May, twenty-five cents per bushel, to be paid in the same manner as in the preceding section.

SEC. 3. Any person claiming bounty under this act shall produce the eggs and grasshoppers thus gathered or killed, as the case may be, before the clerk of the county court in which such eggs or grasshoppers were gathered or killed within ten days thereafter, whereupon said clerk shall administer to such person the following oath or affirmation: You do solemnly swear (or affirm, as the case may be) that the eggs (or grasshoppers, as the case may be) produced by you, were taken and gathered by you, or by person or persons in your employ, or under your control, and within this county and State.

SEC. 4. The clerk shall forthwith destroy said eggs by burning the same and give to the person proving up the same, under his hand and seal, a certificate setting forth in a plain handwriting, without interlineation, the amount of eggs or grasshoppers produced and destroyed by him, and the name and residence of such person producing the same, which certificate shall be in the following form :

“STATE OF MISSOURI, County of ——— :

“This is to certify that ———, in the county of ———, A. B., did this day prove before me that he had gathered, or caused to be gathered ——— of eggs, ——— grasshoppers, and is entitled to the sum of ——— dollars and ——— cents.

“Given under my hand and seal of my office this ——— day of ———, A. D. 18—.

“—————, A. B., Clerk County Court.”

Which certificate shall be received and taken by the collector of revenue of the county in which the same was given, and such collector shall be allowed pay out of the county and State treasury, one-half from each.

SEC. 5. Such clerk shall keep a register of all such certificates given by him, in a book which he shall keep for that purpose, in which he shall note down every certificate granted by him, the number and amount, and to whom granted, and transmit a certified copy of such register, under the seal of the court, to the treasurer of the State, who shall not allow and pay any certificate which does not correspond with such register.

SEC. 6. Such clerk shall receive for his services as aforesaid one dollar for such certified copy of the register, and the regular fee for the certificate and seal, and ten cents

for each certificate granted under this act, all to be paid out of the treasury of his county.

SEC. 7. As the object of this act is the rapid destruction of the locust the ensuing spring, it shall take effect and be in force from and after its passage.

Approved February 23, 1877.

KANSAS.

AN ACT to provide for the destruction of grasshoppers and to punish for violation of this act.

Be it enacted by the Legislature of the State of Kansas :

SECTION 1. That the township trustees of the different townships, and the mayors of cities which are not included in any township of any county within this State, are hereby authorized and it is made their duty, when so requested, in writing, by fifteen of the legal voters of the township or city, to issue orders to the road-overseers of the different road-districts within their respective townships or cities, to warn out all able-bodied males between the ages of twelve and fifty years, within their respective districts, for the purpose of destroying locusts or migratory insects.

SEC. 2. It shall be the duty of road-overseers, immediately after receiving said orders, to proceed at once to warn out all persons liable under section one of this act, giving notice of the time and place of meeting, and the tools to be used, and the kind of work expected to be performed, and all work shall be done and performed under the direction of the road-overseers.

SEC. 3. Any persons over eighteen years of age warned out as is provided in this act may pay the road-overseer the sum of one dollar per day for the time so warned out, and in case any person shall fail to perform labor under this act or paying the sum of one dollar when so warned out, shall be adjudged guilty of a misdemeanor, and on conviction shall be fined the sum of three dollars for each day so failing or refusing, and the moneys so collected shall be expended by the road-overseers in the destruction of grasshoppers in their respective road-districts.

SEC. 4. For the purpose of carrying out the provisions of this act the road-overseer is authorized to enter upon the premises of any person lying within the township where such order of the township trustee is in force, with a sufficient number of hands and teams to perform such labor as he may deem necessary for the public good.

SEC. 5. It shall be the duty of the secretary of the State board of agriculture, immediately after the passage of this act, to compile in circular form all information relating to the manner and means heretofore used for the extermination of grasshoppers, and send at least ten copies of the same to each township trustee in the State.

SEC. 6. This act shall take effect and be in force from and after its publication once in the Commonwealth.

Approved March 6, 1877.

AN ACT providing for a concert of action by senatorial districts for the destruction of grasshoppers.

Be it enacted by the legislature of the State of Kansas :

SECTION 1. That in any senatorial district in the State of Kansas where trouble is anticipated from the ravages of young grasshoppers in the year 1877, and any subsequent year thereafter, it shall be lawful for the counties in said senatorial district to co-operate together in the way and manner herein provided for the destruction of the same.

SEC. 2. The chairman of the board of county commissioners in the county having the largest number of inhabitants in a senatorial district, where two or more counties form said district, may notify the chairman of each of the boards of county commissioners of the remaining counties in said district of the time and place when the chairmen of the several boards of commissioners of the respective counties forming said senatorial district shall hold a joint meeting.

SEC. 3. At such meeting two of their number shall be chosen to act as chairman and secretary, and the proceedings of the meeting shall be published in all the newspapers printed in the senatorial district.

SEC. 4. Said meeting shall designate the manner of procedure by road-overseers, and what day or days the young grasshoppers should be driven from the cultivated land on the unburnt prairie or places of destruction, and shall also designate on what day or days the grasshoppers shall be destroyed, by burning or otherwise, in said senatorial district, giving at least ten days' notice of the same by publishing in the newspapers of the said district.

SEC. 5. The board of commissioners of each county shall notify the road-overseers of said county of the time fixed upon by the joint meeting for the driving and burning, or destroying by other means, of the grasshoppers in the district; said notice to be given to said overseers as soon as practicable after the same shall have been determined by the joint meeting.

SEC. 6. Said road-overseer shall immediately notify the residents of his road-district of the time designated and the manner of procedure, in order to carry out the provisions of this act. He shall also specify what tools or implements will be required of each resident in performing the labor required of him; and such notice may be enforced the same as in the acts authorizing road-overseers to warn out the residents to perform road-labor; and a refusal shall subject such persons refusing to the same penalties as are provided by law in such cases.

SEC. 7. The road-overseer shall direct the manner of performing the labor, and have the supervision of the same, and shall keep a list of the names of those who shall perform labor, and shall certify the number of days' work performed by each, and shall place such certified list in the possession of the board of county commissioners of his county.

SEC. 8. It shall be lawful for two or more senatorial districts to co-operate together under the provisions of this act on a basis of action which they may agree upon.

SEC. 9. This act shall take effect and be in force from and after its publication in the daily Commonwealth.

Approved March 7, 1877.

MINNESOTA.

AN ACT to provide for the destruction of grasshoppers and their eggs.

Be it enacted by the legislature of the State of Minnesota :

SECTION 1. There shall be paid by this State, out of any moneys in the treasury thereof not otherwise appropriated, to any person or persons living within any of the counties in said State afflicted by grasshoppers, the following bounties for catching and destroying of the same and the destruction of their eggs :

SEC. 2. The sum of one dollar per bushel for grasshoppers caught previous to the twenty-fifth day of May next. The sum of fifty cents per bushel from the said twenty-fifth day of May to the tenth day of June. The sum of twenty-five cents per bushel from the said tenth day of June to the first day of July; and twenty cents per bushel from the said first day of July to the first day of October next.

SEC. 3. There shall also be paid, in the same manner, the sum of fifty cents per gallon for any and all grasshopper-eggs taken and destroyed by any person or persons.

SEC. 4. There shall be appointed by the governor a competent person in each township in the several counties so afflicted by grasshoppers, who shall be a resident of the township for which he shall be appointed, to receive, measure, and destroy the grasshoppers and their eggs delivered to him by any person or persons catching and taking the same, which said person so appointed shall take and subscribe an oath for the faithful discharge of his duties, which oath, together with the certificate of appointment, shall be filed in the office of the county auditor, and he shall receive as compensation for his services such sum as the county commissioner may determine, to be paid out of the funds of the county, and in case of necessity, when he cannot perform the duties of his office, said measurer shall have authority and be empowered to appoint a suitable and competent person his assistant, which assistant shall be required to take and subscribe the same oath and be subject to the same penalties as the said measurer.

SEC. 5. The person receiving and measuring the grasshoppers and their eggs as aforesaid shall measure and immediately and effectually destroy the same, and keep an exact account of all the grasshoppers and their eggs received by him and the name of the persons delivering the same, and shall issue a certificate for the amount of grasshoppers and their eggs to the person delivering the same. And he shall, at the end of each week after commencing to receive and measure the same, and on the second day of June, on the eleventh day of said month, on the second day of July, and on the second day of October next, make a report to the county auditor of all the grasshoppers and their eggs measured by him, the number of certificates issued, and the names of the persons to whom he issued the same; and the county auditor shall examine the same and file it in his office, which report shall be subject to public inspection; and the county auditor shall, at the end of each week after he shall have received the first of said reports, transmit a copy of the said reports to the governor, who shall, as soon as the sum hereby appropriated shall have been expended in the payment of said bounties, notify all persons interested therein of such fact by a publication of such notice in some newspaper printed and published at the city of Saint Paul, in said State of Minnesota, for three successive days.

SEC. 6. For a failure on the part of said measurer to perform any of his duties under this act, or for any mismeasurement of such grasshoppers and their eggs, he shall be deemed to be guilty of a misdemeanor, and be subject to pay a fine of not less than ten dollars nor more than one hundred dollars, or be imprisoned in the county jail for a term of not less than thirty nor more than ninety days, in a suit or proceeding to be prosecuted in the name of the State of Minnesota, in the same manner as is provided by law in other cases of misdemeanor.

SEC. 7. Upon the presentation of such certificate to the county auditor, he shall issue a certificate to the person entitled thereto for the amount due him, (a form of which certificate shall be furnished by the State auditor,) and shall make an order upon the State auditor for the amount thereof, and the State auditor shall draw his warrant upon the State treasurer for that amount in favor of the parties holding said certificates, which shall be paid by the State treasurer on presentation: *Provided*, That all certificates presented to the county auditor for payment shall be by him filed and preserved in his office, and he shall present such certificates to the board of county commissioners, who shall audit the same in the manner now provided by law for auditing accounts against counties; and no money shall be drawn from the State treasury until such certificates have been audited and allowed in the manner herein provided. And that no money shall be paid under the provisions of this act at any time prior to the fifteenth day of July, A. D. 1877, and that the money hereby appropriated shall only apply to certificates duly made and filed with the auditor of State or before said day; that at the time after the State auditor shall ascertain the total amount of all claims and certificates so filed, and if the same shall exceed in amount the sum of one hundred thousand dollars, then the said claims shall be paid pro rata, and no other or greater amount than said sum of one hundred thousand dollars shall ever be paid under the provisions of this act: *And provided further*, That if the amount hereby appropriated is not sufficient to pay the certificates in full, the balance shall be paid by the counties respectively, according to the amount due on said certificates as issued by such county.

SEC. 8. Every male inhabitant of the several townships in the said afflicted counties, being above the age of twenty-one years and under the age of sixty years, excepting paupers, idiots, and lunatics, shall be assessed by the board of supervisors of said township to work one day in each week in said township, during the period hereinbefore mentioned for the paying of bounties, for the purpose of catching and destroying grasshoppers and their eggs, for five weeks from the time said grasshoppers shall become large enough to be taken; and the amount of work to be so assessed shall not exceed five days in all.

SEC. 9. The supervisors aforesaid shall make a list of the names of all persons against whom said tax shall have been assessed, and place in a column opposite each name on said list the amount of labor assessed against such person, and shall direct the town clerk to make a certified copy of each list, after which the town clerk shall deliver the several copies to the respective overseers of the highways of said townships.

SEC. 10. The overseers of highways shall give at least two days' notice to all persons assessed to work as aforesaid, living within the limits of their respective districts, of the time and places where and when they are to appear for that purpose, and with what implements.

SEC. 11. Every person liable to work, as provided for in this act, may commute for the same at the rate of one dollar per day, in which case such commutation-money shall be paid to the chairman of the board of supervisors, to be applied and expended by him for the destruction of grasshoppers and their eggs, and he shall be authorized and required to hire and engage some suitable and efficient person to work in the place of said person so commuting, and to pay him the sum of one dollar per day for his services; and every person intending to commute for his assessment shall, within five days after he is notified to appear and work as aforesaid, pay the commutation-money for the work required of him by said notice, and the commutation shall not be considered as made until such money is paid.

SEC. 12. Every person so assessed and notified, who shall willfully neglect or refuse to commute or work as provided by this act, shall be guilty of a misdemeanor, and shall, on conviction thereof, be liable to pay a fine of not less than two dollars nor more than ten dollars, or by imprisonment in the county jail not more than ten days, or both, in the discretion of the court, in a suit to be prosecuted in the name of the State of Minnesota, in the same manner as is provided by law for prosecutions of misdemeanors.

SEC. 13. There shall be appropriated, out of any moneys in the treasury of this State not otherwise appropriated, for the purpose of carrying out the provisions of this act, the sum of one hundred thousand dollars.

SEC. 14. The board of county commissioners of any county in this State afflicted by grasshoppers shall have the right, if in their judgment they see fit, to employ one or more persons in each township in said county, with such implements or mechanical contrivances as may prove most efficient, to destroy the grasshoppers from the first day of April to the first day of August in each year, paying such persons either by the day or a specified sum for the amount captured and destroyed. The compensation of such person shall be paid out of the general fund of the county: *Provided further*, That parties employed and paid by the county commissioners shall not receive any other or further compensation under the provisions of this act.

SEC. 15. This act shall take effect and be in force from and after its passage.

Approved March 1, 1877.

NEBRASKA.

AN ACT to provide for the destruction of grasshoppers.

Whereas the State of Nebraska has, for the past three years, been devastated by the grasshoppers, thereby greatly injuring the agricultural and commercial interests of the State; and whereas these interests are liable to be seriously damaged in the future by the recurrence of the pests aforesaid: therefore,

Be it enacted by the legislature of the State of Nebraska:

SECTION 1. That the supervisors of each road district in this State shall, at the time when the grasshoppers shall have been hatched out, and before the same shall become full fledged and fly, notify each able-bodied male resident of his district, between the ages of sixteen and sixty years, to perform two days' labor, at such time and at such place and in such manner as shall by said supervisors be deemed most efficient in the destruction of the grasshoppers; said notices shall be given in the same manner as is provided by law for the notice to work upon public highways.

SEC. 2. Cities of the first and second class shall be governed by the provisions of this act, and it shall be the duty of the mayor of such cities to appoint, not exceeding two supervisors for each ward, to oversee the labor to be performed under the provisions of this act.

SEC. 3. In case it shall appear that two days' work is not sufficient to destroy the grasshoppers in any district or ward, and it shall further appear that more time can be profitably employed in the destruction of the grasshoppers, the supervisors of each ward or road district may require from the persons liable to the provisions of this act, not exceeding ten days' labor in addition to the time hereinbefore mentioned, and it shall be the duty of such supervisor to give to each person who shall have performed labor under the provisions of this section a receipt for the number of days' labor performed, and the supervisor shall upon oath report to the city or county authorities the names and amount of labor performed by each person.

SEC. 4. It shall be the duty of all persons subject to the provisions of this act to attend when notified as herein provided, and labor under the direction of the supervisor of their respective district or ward. Any person who, after being notified, shall refuse, neglect, or fail to comply with the provisions of this act, shall forfeit and pay to the county or city treasurers, as the case may be, the sum of ten dollars, together with costs of suit, which sum shall be collected by suit before any justice of the peace within the county, in an action to be brought in the name of the city or county.

SEC. 5. The supervisor shall report, under oath, to the city or county authorities the names of all persons who shall have refused or failed to comply with the provisions of this act.

SEC. 6. This being a case of emergency, this act shall take effect and be in force from and after its passage.

SUMMARY OF REMEDIES.

The publication of a second edition of this bulletin permits the summing up of the directions contained therein, with some additional experience recently gained in the field.

The means of destroying the young locusts necessarily vary somewhat with the nature of the soil and of the crops, and we give in this connection principles rather than details. For convenience these may be classified into: 1, burning; 2, crushing; 3, trapping; 4, catching; 5, the use of destructive agents.

1. *Burning*.—In a prairie and wheat-growing country like much of that which this locust devastates, burning is perhaps the best means of warfare against the young. These, for some time after they hatch, may be driven, as already suggested, into windrows or heaps of straw scattered around and through a field and burned. During cold, damp weather they will, of their own accord, congregate under such shelter, and may sometimes be exterminated by burning, where no driving is necessary. As to burning the prairie in the spring, while there is much to be said pro and con, it is, all things considered, beneficial in this connection. Scarcely any eggs are laid in rank prairie, and the impression that locusts are slaughtered by myriads in burning extensive areas, is a false one. It is beneficial principally around cultivated fields and roadsides,

from which the locusts may be driven, or will of themselves pass for the shelter the prairie affords.

When a wheat field is attacked by the young in their usual method of commencing on one side and eating somewhat regularly across it, many may be destroyed by spreading straw over them in the evening about the time they cease eating. They will collect upon this, and if it is fired very early in the morning many will be destroyed before they commence moving.

The burning of extensive prairies after the bulk of the locusts hatch destroys the nests and eggs of some game birds which feed upon the locusts, but the birds themselves always escape and nest again; whereas many noxious insects, like the chinch bug, are killed; so that, even leaving the locust question out of consideration, the burning would yet prove advantageous to man.

2. *Crushing*.—Can be resorted to with advantage only in exceptional cases, where the ground is smooth and hard.

3. *Trapping*.—This is very effectual, especially when the insects are making their way into a field from roads and hedge-sides. The use of converging nets, as described on page 6, is important in this connection.

Ditching or trenching will come under this head; and after the insects have commenced to travel in schools, proper ditching is the most effectual protection, as recommended on page 5.

There will be much premature judgment passed upon ditching by those who employ it against the very small and newly-hatched locusts which more easily crawl up a perpendicular bank than the larger ones; but we speak from past experience, and would urge all who are threatened, to employ this mode of protection from now on.

Where the soil is tenacious, and water or a little kerosene can be used at the bottom, all the better; and the side to the garden, orchard, nursery or field to be protected should be kept friable by means of a fine rake. In proportion as the soil is loose and apt to fill up by strong winds, ditching will fail.

4. *Catching*.—There are innumerable mechanical contrivances for this purpose. Many useful designs have already been submitted to the Commission. The cheapest and most satisfactory are those intended to bag the insects. A frame two feet high and of varying length, according as it is to be drawn by men or horses, with a bag of sheeting tapering behind and ending in a small bag or tube, say one foot in diameter and two or three feet long, with a fine wire door at the end to admit the light and permit the dumping of the insects, will do admirable work. The insects gravitate toward the wire screen, and when the secondary bag is full they may be emptied into a pit dug for the purpose. These bagging-machines will prove most serviceable when grain is too high for the kerosene pans, presently to be described.

A curious suction-fanning machine has been invented by Mr. J. C. King, of Boulder, Colo., and may be mentioned in this connection. A strong draft sucks the insects up through an elongate mouth with lips that run near the ground, and draws them up through two funnels and knocks them to pieces. We have seen the working of that in Mr. T. C. Henry's possession at Abilene, Kans. It is an admirable invention, and may be improved so as to be of great service; but on account of its expense will scarcely compete with the more simple methods.

5. *Use of destructive agents*.—Kerosene is the most effective. It may be used in any of its cruder forms. In Colorado they use it to good advantage on the water in their irrigating-ditches, and it may be used anywhere in pans or in saturated cloths, stretched on frames, drawn

over a field. A good and cheap pan is made of ordinary sheet-iron, eight feet long, eleven inches wide at the bottom, and turned up a foot high at the back and an inch high at the front. A runner at each end, extending some distance behind, and a cord attached to each front corner, complete the pan, at a cost of about \$1.50. A similar pan on wheels, and moved by a handle behind, may be operated by a single person to good advantage.

We have known from seven to ten bushels of young locusts caught with one such pan in an afternoon. It is easily pulled by two boys, and by running several together in a row, one boy to each outer rope and one to each contiguous pair, the best work is performed at the least labor. Heavier or longer pans, to be drawn by horses, should have transverse partitions to avoid spilling of the liquid; also more runners. The oil may be used alone so as to just cover the bottom, or on the surface of water, and the insects strained through a wire ladle. When the insects are very small, one may economize in kerosene by lining the pan with saturated cloth; but this becomes less efficient afterward, and frames of cloth saturated with oil do not equal the pans. Where oil has been scarce, some persons have substituted concentrated lye, but when used strong enough to kill, it costs about as much as the oil. The oil-pans can only be used when the crops to be protected are small.

Small pans for oil, or for burning on the principle of that made by Mr. Hetzel, mentioned on page 7, attached to an obliquing pole or handle, do excellent service in gardens.

Recently a machine for destroying the young locusts has come into extensive use in Minnesota. This consists of a sheet-iron pan, with the back elevated and curved; it is covered with coal-tar, which fastens the insects falling upon it. When the tar is covered with insects they are burned. These pans may be drawn or pushed, as suggested in reference to the kerosene-pans.

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